

Notice of Allowability

Application No.

10/810,164

Examiner

Srirama Channavajjala

Applicant(s)

WU ET AL.

Art Unit

2166

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☐ This communication is responsive to 1/4/07.
2. ☒ The allowed claim(s) is/are 1,3,6,14,15,20,22,25 and 31-33.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
- (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input checked="" type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date <u>3/5/2007</u> . |
| 3. <input type="checkbox"/> Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date _____ | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____ |

DETAILED ACTION

1. Claims 1,3,6,14-15,20,22,25,31-33 are allowed
2. Examiner acknowledges applicant's amendment filed on 1/4/2007.
3. Claims 1,14, 20-25 have been amended [1/4/2007].
4. Claims 9-13,17-19,27-30 have been cancelled [1/4/2007].
5. Claims 31-33 have been added [1/4/2007].

Drawings

6. Examiner acknowledges applicant filed "**Replacement Sheet**" prior art fig 1A-1B on 3/9/2007.
7. The Drawings filed on 3/26/2004 are acceptable for examination purpose

Information Disclosure Statement

8. The information disclosure statement filed on 3/26/2004 is in compliance with the provisions of 37 CFR 1.97, and has been considered and a copy was enclosed with previous Office Action mailed on 10/3/2006.

35 USC § 101

9. In view of applicant's amendment to the claims, and specification [as given below], the rejection under 35 USC 101 as set forth in the previous office action is hereby withdrawn.

Interview:

10. Applicant's Attorney Aslam A. Jaffery, Regd. No. 51,841 is thanked for the telephone interview on 05 March 2007. During that telephone interview Aslam A. Jaffery granted authorization to ***amend claims: 1,3,6,14-15,20,22,25,*** canceling claims: 2,4-5,7-8,16,21,23-24,26, amendment to the specification at page 8, paragraph [0021].

EXAMINER'S AMENDMENT

11. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Applicant's Attorney Aslam A. Jaffery, Regd. No. 51,841 on 05 March 2007.

The application has been amended as follows:

IN THE SPECIFICATION:

Please amend paragraph [0021] as follows:

[0021] Various embodiments of the present invention may be provided as a computer program product, which may include a machine-readable medium having stored thereon instructions, which may be used to program a computer (or other electronic devices) to perform a process according to various embodiments of the present invention. The machine-readable medium may include, but is not limited to, floppy diskette, optical disk, compact disk-read-only memory (CD-ROM), magneto-optical disk, read-only memory (ROM) random access memory (RAM), erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), magnetic or optical card, flash memory, or another type of media/machine-readable medium suitable for storing electronic instructions. ~~Moreover, various embodiments of the present invention may also be downloaded as a computer program product, wherein the program may be transferred from a remote computer to a requesting computer by way of data signals embodied in a carrier wave or other propagation medium via a communication link (e.g., a modem or network connection).~~

IN THE CLAIMS:

1. **(Currently Amended)** A ~~method~~, method for garbage collection comprising:

allocating a single space to accommodate a mark bit and an allocation bit, the
mark bit and the allocation bit relating to garbage collection occurring at a
virtual machine;

integrating the mark bit and the allocation bit into a single mark/allocation bit at
the single space to free other spaces for other system functions; ~~and~~

corresponding the mark/allocation bit with an object in a heap, wherein the
mark/allocation bit occupies the single space, the mark/allocation bit to
perform dual functions of the mark bit and the allocation bit by alternating
between the mark bit and the allocation bit via the single space[.];

resetting the mark/allocation bit, and switching the mark/allocation bit to the
allocation bit to perform root set enumeration, wherein the performing of the
root set enumeration comprises lazy and selective root set enumeration,
wherein the lazy and selective root set enumeration comprises lazily and
selectively identifying the root object in a segment of the heap and
regenerating the allocation bits for the root object and other objects
associated with the root objects residing in the segment of the heap;

resetting the mark/allocation bit, and switching the mark/allocation bit to the mark bit to perform marking and scanning of objects using the identified object;

marking the identified object as a root object;

scanning one or more objects associated with the root object by utilizing the mark/allocation bit as the mark bit;

marking the scanned one or more objects associated with the root object; and
providing mark/allocation bit information being displayed at the client.

2. (Cancelled)
3. **(Currently Amended)** The method of claim-2_1, further comprises performing the root set enumeration by utilizing the mark/allocation bit as the allocation bit to conduct pointer identification of the object in the heap.
4. (Cancelled)
5. (Cancelled)
6. **(Currently Amended)** The method of claim-5_1, further comprising:

retaining the marked root object and the marked one or more objects associated with the root object; and

regenerating allocation bits for the retained objects.
7. (Cancelled)
8. (Cancelled)

9. (Cancelled)
10. (Cancelled)
11. (Cancelled)
12. (Cancelled)
13. (Cancelled)
14. **(Currently Amended)** A ~~system,~~ system for garbage collection comprising:

a client having a processor and a memory; and

a server coupled with the client, the server having a processor and a memory,

the server further having

an allocation interface to allocate a single space to accommodate a mark bit and
an allocation bit, the mark bit and the allocation bit relating to garbage
collection occurring at a virtual machine[[:]],

an integration module to integrate the mark bit and the allocation bit into a single
mark/allocation bit at the single space to free other spaces for other system
functions; and,

a correspondence unit to correspond the mark/allocation bit with an object in a
heap, wherein the mark/allocation bit occupies the single space, the
mark/allocation bit to perform dual functions of the mark bit and the
allocation bit by alternating between the mark bit and the allocation bit via
the single space[[:]].

a resetting routine to reset the mark/allocation bit, and a switching module to switch the mark/allocation bit to the allocation bit to perform root set enumeration, wherein the performing of the root set enumeration comprises lazy and selective root set enumeration, wherein the lazy and selective root set enumeration comprises lazily and selectively identifying the root object in a segment of the heap and regenerating the allocation bits for the root object and other objects associated with the root objects residing in the segment of the heap,

the resetting routine to reset the mark/allocation bit, and the switching module to switch the mark/allocation bit to the mark bit to perform marking and scanning of objects using the identified object,

a mark/scan unit to mark the identified object as a root object, to scan one or more objects associated with the root object by utilizing the mark/allocation bit as the mark bit, and to mark the scanned one or more objects associated with the root object, and

providing mark/allocation bit information being displayed at the client.

15. **(Currently Amended)** The system of claim 14, further comprising:
- ~~a resetting routine to reset the mark/allocation bit;~~
 - ~~a switching module to switch the mark/allocation bit to the allocation bit to~~
~~perform root set enumeration; and~~
 - a root set enumeration module to perform the root set enumeration by utilizing
the mark/allocation bit as the allocation bit to conduct pointer identification of
the object in the heap.
16. (Cancelled)
17. (Cancelled)
18. (Cancelled)
19. (Cancelled)
20. **(Currently Amended)** A machine-readable medium comprising instructions
which, when executed to perform garbage collection, cause a machine to:
- allocate a single space to accommodate a mark bit and an allocation bit, the
mark bit and the allocation bit relating to garbage collection occurring at a
virtual machine;
 - integrate the mark bit and the allocation bit into a single mark/allocation bit at the
space to free other spaces for other system functions; ~~and~~
 - correspond the mark/allocation bit with an object in a heap, wherein the
mark/allocation bit occupies the single space, the mark/allocation bit to

perform dual functions of the mark bit and the allocation bit by alternating between the mark bit and the allocation bit via the single space[[]];

reset the mark/allocation bit, and switching the mark/allocation bit to the allocation bit to perform root set enumeration, wherein the performing of the root set enumeration comprises lazy and selective root set enumeration, wherein the lazy and selective root set enumeration comprises lazily and selectively identifying the root object in a segment of the heap and regenerating the allocation bits for the root object and other objects associated with the root objects residing in the segment of the heap;

reset the mark/allocation bit, and switching the mark/allocation bit to the mark bit to perform marking and scanning of objects using the identified object;

mark the identified object as a root object;

scan one or more objects associated with the root object by utilizing the mark/allocation bit as the mark bit;

mark the scanned one or more objects associated with the root object; and

provide mark/allocation bit information being displayed at the client.

21. (Cancelled)

22. **(Currently Amended)** The machine-readable medium of claim-24 20, wherein the instructions which when executed, further cause the machine to perform the root set enumeration by utilizing the mark/allocation bit as the allocation bit to conduct pointer identification of the object in the heap.
23. (Cancelled)
24. (Cancelled)
25. **(Currently Amended)** The machine-readable medium of claim-24 20, wherein the instructions which when executed, further cause the machine to:

retain the marked root object and the marked one or more objects associated

with the root object; and

regenerate allocation bits for the retained objects.
26. (Cancelled)
27. (Cancelled)
28. (Cancelled)
29. (Cancelled)
30. (Cancelled)
31. **(Previously Presented)** The method of claim 1, wherein the virtual machine comprises a Java virtual machine.

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32. (Previously Presented) The system of claim 14, wherein the virtual machine comprises a Java virtual machine.
33. (Previously Presented) The machine-readable medium of claim 20, wherein the virtual machine comprises a Java virtual machine.

Pursuant to MPEP 606.01 the Title is changed to read

***--METHOD AND SYSTEM FOR GARBAGE COLLECTION WHEREIN
RESETTING THE MARK/ALLOCATION BIT,AND SWITCHING THE
MARK/ALLOCATION BIT TO THE MARK BIT TO PERFORM MARKING AND
SCANNING OF OBJECTS USING THE IDENTIFIED OBJECT AS A ROOT OBJECT
AND PROVIDING MARK/ALLOCATION BIT INFORMATION BEING DISPLAYED AT
THE CLIENT--***

Reasons for allowance

The following is an examiner's statement of reasons for indication of allowable subject matter: The prior art of record either along or in combination fails to anticipate or render obvious, the recited feature "selectively identifying the root object in a segment of the heap and regenerating the allocation bits for the root object and other objects associated with the root objects residing in the segment of the heap; resetting the mark/allocation bit, and switching the mark/allocation bit to the mark bit to perform marking and scanning of objects using the identified object" in claim 1,14,20.

These features, together with the other limitations of the independent claims are novel and non-obvious over the prior art of record. The dependent claims 3,6,15,22,25,31-33 being definite, enabled by the specification, and further limiting to the independent claims is also allowable.


The newly cited reference WO 02/23345 issued to Rodriguez Rivera,G et al. published on 21 March 2002 is directed to garbage collectors used with generally memory allocators,more specifically garbage collector to be used with the heap management functions provided by an allocator which is independent of the garbage collector. When garbage needs to be collected, the allocator builds the table and invokes the garbage collector, which uses the table in its mark phase to determine what blocks are not currently in use. In the sweep phase, the garbage collector uses the

allocator's free function to return the blocks that are not in use to the free list. The garbage collector also uses the table in the mark phase to make a blacklist of potential blocks that are pointed to by false pointers and therefore should not be allocated by the allocator when the allocator next expands the heap. When garbage collector returns, the allocator uses the blacklist to decide which of the blocks in the expanded portion of the heap may be added to the free list [see Abstract, page 7, line 21-29].

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Srirama Channavajjala whose telephone number is 571-272-4108. The examiner can normally be reached on Monday-Friday from 8:00 AM to 5:30 PM Eastern Time.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alam, Hosain, T, can be reached on (571) 272-3978. The fax phone numbers for the organization where the application or proceeding is assigned is 571-273-8300 Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free)

SC
Patent Examiner.
March 9, 2007.


SRIRAMA CHANNAVAJJALA
PRIMARY EXAMINER